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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

06725

Distribution
LIMITED

ID/WG.219/4
24 October 1975

Original: ENGLISH

United Nations Industrial Development Organization

Regional Consultation for the Arab Countries of the
Middle East and North Africa on Licensing of Technology
with Reference to the Petrochemical and Fertilizer Industries

Tripoli, Libyan Arab Republic, 1 - 6 December 1975 BENGHAZI

Organized in co-operation with

Industrial Development Centre for Arab States (IDCAS)
General Organization for Industrialization, Libyan Arab Republic

TRANSFER OF PROPRIETARY TECHNOLOGY OF PETROCHEMICAL PROCESSES 1/

by

Donald F. Othmer*

*/ Distinguished Professor, Polytechnic Institute of New York, Brooklyn, USA

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id.75-8017

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SUMMARY

The transfer of any commodity is possible only when the buyer is convinced that he is obtaining a fair value for his payment. The seller of proprietary information must convince the purchaser of this fact before the sale - often without being able to divulge completely what he is selling. If he tells too much and without protection, he may find that he has given away what he wanted to sell.

Methods used in transferring technology which is proprietary and often secret include: (a) hiring of consultants who may have acquired the technology in earlier work; (b) purchasing of patents, when these are available as a means of formalising the capital value of technology; (c) including technology with a purchase of process engineering and mechanical design for a first plant; (d) including technology with all hardware and its installation as part of the purchase of a turn-key installation; (e) taking equity in return for all technology in a joint venture with capital and other tangibles supplied from the host country on some agreed upon ratio of participation; (f) bartering technology for what is regarded as equivalent technology of the other party; (g) gradual disclosure of technology against payment for its transfer in steps, and the successful operation successively on bench scale, then in a pilot plant, and a demonstration plant. Still other methods and variations of these are used to protect both sides of the transfer.

Because non-industrial countries are unfamiliar with research techniques, it is difficult to transfer to them processes and other technology which have not been fully demonstrated and proven in large size units, since an undeveloped country is usually not adapted to the necessary scale-up and development programs.

INTRODUCTION

The rate of a country's advancement in technology measures its industrialisation and cultural maturity. Technology, is at its highest levels in the most industrialized countries where it has been accumulated by the numerous producers of goods for sale on the worlds markets. Like a Book of Euclid's Geometry, each demonstration of technology is the logical summation of those exercises in learning and practice which have gone before. Each new technical achievement has been assembled slowly, and often at considerable expense of research time, effort, and funds - then to become one of the foundation stones for a subsequent achievement in the same field, or sometimes quite dissimilar field.

Often in the history of industry there is a need for some new solution to a universal problem. The same technology may then be developed almost simultaneously by several or more different groups in one or more countries, as each group advances along parallel lines. The different groups come up then with the same or possibly different solutions of varying merit. If more than one solution is developed, there results the healthy condition of competitive processes, with opportunities to compare the relative advantages of each.

The accumulation of technology in a developing country may be very slow because the climate for research is usually not the best; and even "re-inventing the wheel" or repeating the research to come up with equivalent technology to give a known result will take a long time, and much money.

In the U.S., as an example of a heavily industrialized country, the total annual bill for research in all fields is about $30 billion. Just duplicating this expenditure in any one field is very costly. But very

important in obtaining research results, as compared to the simple expenditure of money, are the highly educated, trained and experienced people in the highly organized laboratories fitted with such sophisticated equipment. Especially also for research groups is the complete integration of all of the components with the feeling and spirit for research which comes only after a history of achievement of important accomplishments.

Thus the self development of technology in any reasonable number of years by a non-industrial nation to permit it to come abreast with and then compete in world markets seems to be quite impossible. It starts too far behind; and its rate of growth in technology is always slower - it is the frog in the well which slips back two feet for every foot jumped toward the top.

A corollary of this theorem is that the training of the necessary scientists and engineers will be done too slowly if each small developing country builds its own university and must wait for its education of its own leaders. Such universities must be built, and the sooner they are started, the sooner they will mature, but meanwhile the available educational facilities may be used in America and Europe much more cheaply and with a relatively early output of young scientists and engineers, also broadened in outlook by their international experiences while away at school.

Highly industrialised as Japan was at the end of World War II, its powerful Ministry of International Trade and Industry (MITI) promptly decided that since it was so far behind the other great industrial countries:- (a) it could not afford either the money, but especially the time,

required for it to catch up through its own research, hence [illegible] it must and would buy at any reasonable price the technology needed in thousands of instances of technical assistance to its industry. Furthermore, in order to give the aid of a comprehensive patent system to such transfer of proprietary information, foreigners who were unable to file applications for patents during the war years were allowed to do so in the Japanese patent office within a reasonable period of time and thus have the time benefit. This prevented the copying of foreign technology without license, and thus encouraged Western companies to negotiate for its fair and orderly transfer.

The Japanese soon satisfied themselves that the transfer of finished and proven technology from a more industrialised country allows progress to be made very much more quickly; and it is almost always much less expensive than starting from scratch, regardless of how good the available research facilities may be. Most important is that the new technology, starting in mature bloom, is making profits all of the time it otherwise would be growing from inception.

Complete technology in many common manufacturing processes has been available for so long that it is more or less standardized. Hence complete information, process engineering, and the plant itself for such a production may be obtained almost "off the shelf". Thus a raw sugar mill or even a sugar refinery, a pulp and a paper mill, a petroleum refinery, a natural gas stripping and liquifaction plant, all may be bought with the accompanying and almost standardized technology - none of which might be regarded as necessarily proprietary - almost as if the hardware were the sole consideration. In the case of newer or more

sophisticated plants, proprietary technology becomes important. However, many experienced engineering companies pride themselves on not being the owners or sellers of proprietary information. They say that then they can be unbiased in the sale of any particular process or plant which the client prefers. Such companies may, however, be willing to negotiate for the license of such proprietary information, when necessary on behalf of their clients, for engineering and/or for complete plants.

On the other hand newly available processes and technology may be very much better than the older, standardized ones; and since the improved, modern techniques are still in the province of those who have had the expense of developing them, it is essential to find means of transfer of proprietary technology, which means will pay off the development expenses; and, in every way, will benefit and satisfy both parties.

The value to the purchaser of most tangible articles of commerce, for example, an automobile, may be readily determined through complete inspection, a free trial period and thorough comparison with competitive items which are available and are also offered to the knowledgeable purchaser. Intangibles are always more difficult for the buyer to evaluate, particularly when they comprise proprietary technology. Complete disclosure by the owner to allow the buyer to appraise fully its value to his needs may leave the owner with nothing to sell - he has given away freely the knowledge so very valuable to both. Numerous examples of this sad result may be given. However, sometimes the receiver of what he thought was all of the information necessary, indeed did not receive all from the owner who was trying to make the sale; or the receiver may not

have parted with the ignorance of some part of the information and technology actually disclosed. When the receiver then tried to work it out on his own, he had unforeseen difficulties.

On the other hand, many an individual inventor or corporate owner of valuable technology has been unable to be persuaded to disclose sufficient about the intangible property so that the worth could be appreciated in terms of the actual knowledge of the potential buyer, who then found an alternative. And an equal number of developers of technology have become very conceited as they watched the growth of their individual development - and thus have appraised its value over-highly. Then, either they have completely discouraged potential buyers by the high price asked, or else they have encouraged the potential buyer to appropriate and use what knowledge he was able to obtain and develop by himself to commercialisation without benefit to the original owner.

These considerations merely point up the axiom that "You cannot sell an idea - no one will buy it; you can only give it away." Necessary for such a sale of proprietary technology is hard evidence of its value which is only exemplified by the idea.

There are various means, however, which have been used successfully to protect and satisfy both parties in the transfer of proprietary technology. Some of these may be considered with examples taken from technology related to chemicals, and other materials derived from petroleum. However, the basic considerations and mechanisms used will be the same throughout the entire Chemical Process Industries.

I. SCIENTIFIC AND ENGINEERING EDUCATION

There is a first requisite in obtaining and using the technology of petrochemical processes or of any other technology by Arab countries for their industrialization. This is the organization and cultivation of a staff of technically trained men in each country - particularly educated in those general disciplines of science and engineering in which are based the processes concerned.

Such well educated, but not immediately experienced or seasoned technologists can, of course, be hired from non-Arabian countries. But they will necessarily have prejudices, if nothing more, in relation to their former activities, work, and employers. In any case, they will be expensive if looked upon, not only as the negotiators and recipients of the technical information in question, but then also as the constructors, and finally as the ultimate operators of the plants to be built to produce petrochemicals and other products using natural gas and crude oil as the basic feedstocks.

There are now established a few, relatively new, Arab universities with science and engineering majors - often with Western European and American instructors. The newspapers noted (June 1975) that a group of American engineering and architectural firms had been retained to design and develop a $1 billion campus for the University of Riyadh in Saudi Arabia over a sever year period. The date for completion of construction and staffing was not indicated.

More such universities should be endowed, planned, and encouraged in each Arab country. However, the growth to maturity of a university - so

that it can stand among the peers throughout the world is like the development to maturity of a [illegible]. Nevertheless can be accomplished within a few years. And without waiting for these fine Arabian universities, which will be great in years to come, trained engineers and scientists are needed as soon as possible. - for evaluation of the technology offered from the industrial countries; for negotiating contracts therefore; for following and checking the planning and designing of producing plants; and then for supervising their construction, operation, maintenance, and growth.

The quickest and cheapest method of training the available youth is through the established facilities of European and American Technical Universities. American schools are outstanding in many fields, including chemical engineering, petrochemical engineering, high polymers theory, also in the practice of utilization of such theory in making plastics, resins, surface coatings, films, fibers, etc.

Consider an Arab country which would like to start into collegiate training in science and technology 100 men per year who have been well trained through the secondary school level. If they are to go abroad for their studies they must have, as a first requisite, a thorough competence in the language of the country where they would attend a University. Assuming that 75 returned after 4 years with bachelor's degrees and 25 stayed on for an average of 3 more years of graduate studies. This would give, in effect a composite university; however, it would be thoroughly fractionated with its students on many campuses. There would be a total of something like 500 students - with some allowance for attrition - obtaining the best education and experience the world affords, from many different schools. If

the average cost to the Arab Country per man annually was $6,000 more or less, this might indicate a budget of [illegible],000,000 per year which would be a small amount compared to that required for building (amortizing capital charges) and operating a university at home. This annual amount would also be quite small considering it as an investment in the future of the country by way of the development of its most promising and carefully selected youth, its major asset. The monetary sum does not begin to include the broad advantages to the men - and in sum total to the country of:-

a) The opportunity for these picked men to learn and partake of the breadth and experience of the thousands of world famous scientists and engineers under whom they would study.

b) The broadening effect to the men themselves of leaving their own relatively narrow lives in the small communities and countries where they have lived, and traveling to and observing the quite different cultures, civilization, and methods of living and doing business of industrialized countries.

c) Another important advantage - and this can neither be evaluated in, nor bought with dollars - would be the contacts and friendships made with their fellow students and other Europeans and Americans with whom, in some cases, they might later be doing business, or at least enjoy knowing in maturity, with a common feeling and appreciation of the other's background of civilization and culture.

II. TECHNICAL AND ECONOMIC REPORTS - FEASIBILITY STUDIES

The first essential step in carrying out any venture involving new technology is a feasibility study. Sometimes, this is very informal - even too informal, it may simply involve the decision of one man to go ahead based on his feeling - or desire to implement the project - that the profits or other advantages are significantly greater than the disadvantages. Instead of such a casual or dramatic decision, a very careful study or survey and a complete economic and technologic analysis and report should be prepared. This will weigh against each other, as a background for definite planning, all foreseeable aspects of old, new, and future technology and patents; costs of plant, of raw materials, and of production - hence of the cost of the final products and their markets. Further studies must include selling prices of products, hence the expected profits and the pay out time for the investment; present and possible future local and world markets; competition with new products made with possible new technologies, etc.

Such an analytic report if made by some one other than the potential purchaser, will not usually include the transfer of the necessary proprietary technical information. However, it must be prepared by someone sufficiently familiar with the subject industry to analyse the different technologies which may be available. A comparison must be made of the demonstrated costs of relative processes and products, their respective advantages and disadvantages, patent positions, chances of technical survival under present and future competition, etc.

The general aim of this feasibility report should be to organise and present all of the technical, economic, marketing and other information

necessary to enable the decision maker to analyse the overall situation and to determine, first, whether to proceed; and if that is affirmative, then where to obtain, and how to effect the obtaining of the necessary technology. In this decision on technology to be obtained there must be considered particularly the present and prospective markets, and the present and possible future competition of other products including newer ones, particularly as this competition will result from new research developments in the more industrialised nations.

More than 150 such analyses, reports, on the status of research, development and manufacturing practice in individual fields at the forefront of then current technical advances have been prepared during the last 25 years for companies overseas with the accompanying recommendations as to future procedure by this writer and his colleagues and associates. The clients have always been looking to the United States and to some other highly industrialised countries for advanced technology and its transfer to themselves; and such technologies and their status at the particular time were the background of all such feasibility reports. Most of these analyses, reports and recommendations were in the fields of petrochemicals, including as ultimate products: - petrochemicals, man-made fibers, resins, plastics, sheetings and films, surface coatings, ammonia based fertilisers; also electronic metals, sophisticated electrochemical developments, water desalination techniques, building materials as special bricks, tiles, and blocks, new thermal insulation materials, and similar items. In many cases, the feasibility studies affirmed the desirability and profitability of the suggested program; and it became necessary to arrange for the transfer,

internationally, of the necessary technology, often - but not always - of a proprietary nature.

It goes without saying that year by year there have been many changes in the subjects and the nature of such analyses, feasibility reports of technology, economics and marketing, also recommendations as to whether or not to proceed with the venture in question. As the chemical industry of the world has been progressing, always to what has been considered new and better things, there is always the necessity of supplying these new technologies to clients who must insist before going into any new project that they will be knowledgeable and competitive with the latest technology in every country.

Also in these last years, this writer has been invited to make an overall survey of two quite different countries and report on which of the Chemical Process Industries should be developed from the standpoint of natural raw materials, domestic needs, and export markets. In general this is a magnified feasibility study - country wide - and might well be considered as a pre-requisite for industries' expansion in countries wherein the future opportunities are vastly greater than those of the past.

III. CONSULTANTS

Such analysis and reports by outside experts may be only another facet of consulting arrangements, with most of the time of the consultants being spent, however, outside of the country - since, indeed, most of the data collection, analysis, and report preparation may be better done in the expert's own office. Often, however, a consultant may spend most of his time in the developing country doing or supervising most of the development and process design - even mechanical design - work on location. Primarily the consultant is calling mainly on his own past experience and his own built-in knowledge and ability to do the job in hand. He may be in a position to transfer a great deal of technology directly to the essential project. He may motivate and help plan, but usually he does not execute, or supervise the building and operation of the working plants.

Or more often, he may be principally an adviser to the local enterprise in evaluation and purchase of the proprietary technology which then is supplied by others.

IV. PATENTS AND TRADE SECRETS

Commerce and industry have been aided for centuries by the granting by a government, to an individual or a company, of specialised monopolies. These are, necessarily, within very closely defined and narrow limitations. The grantee could then engage without competition in some business, trade, manufacture of a particular product, or process for such manufacture, or other gainful pursuit. Originally, these awards were in the form of what were called patent grants for some defined amount of land, often more or less unknown, and previously quite valueless in a newly discovered and quite undeveloped territory.

The circles of latitude reaching west from the Atlantic Coast and forming the north and south boundaries of many of the present American states bordering the Atlantic ocean - also at least one arc of a circle a number of miles away from a fixed point - date back to the original patents or grants of land by British sovereigns. These were carved out in London from American wilderness of the 16th and 17th centuries, always without benefit of a map worthy of the name. In return, the patentee agreed to settle the land so that the new inhabitants would develop sufficient trade with the mother country to return a profit.

And in the third quarter of this century, one of the good friends of the writer received a patent grant in return for his help to Franco in winning the Spanish civil war. This included rights to the wood in the forests within a specified distance of the shores and estuaries of Spanish Guinea, under the Equator, on the west coast of Africa.

More usually now, however, a patent is given after more or less complicated legal manoeuvers, to an inventor of something new and valuable - or to his employer. This is a monopoly "to make, use, and sell" a particular new and hitherto unknown but useful and commercially valuable: - (a) article, machine, or device; (b) process for making a useful product or otherwise accomplishing a useful operation, purpose, or chemical reaction; and in some countries (c) composition of matter (i.e., the patenting of the chemical makeup of a material or of a specified mixture of substances having unique properties and advantages in some use), also (d) plant such as a yeast, flower, vegetable, fruit or tree.

This patent monopoly is, of course, limited to the use within the country granting it and to the territorial extent of its sovereignty; although such patents, often separately, are obtained by an inventor or his agents in as many as 30 or 40 different countries.

The patent is a contract between the government and the patentee whereby: - in return for the benefit to him of a monopoly forbidding all but him the use of the invention for a period of time, usually between 15 and 20 years, depending on the country, the patentee makes a complete disclosure in the patent document of all aspects of the invention. Thus, everyone then has full knowledge of the published invention and may use it freely, after the monopoly to the inventor of the patent has expired.

Sales or other transfers of processes and related technology are readily arranged on the basis of the "full and complete" disclosure of such patents when the purchaser is willing to allow or license others also to use the technology within the domain of the patent monopoly. The limitation

is the extent of the territory of the government which granted the patent. The patent, itself, provides that the patentee, at his option and on his terms, may sell or license all or a part of his monopolistic rights to others, thus the patent is a deed to a definite piece of property - clearly defined and limited - although, in a sense, quite intangible.

In all history, and in almost every type of patent grant, the item granted is usually without tangible or appraisable value at the time of the grant by a governmental authority, who owned it or could grant it, or could restrict its use. Quite usually, the patent may be regarded as of somewhat a negative value in that the open and presently unused value, whatever it may be, is prohibited in use to everyone else except the patentee.

However, the governmental authority looks to the grantee to make this item valuable at some future time, thus the government will benefit - without the cost to itself - in the later development of the patent grant. In the case of the technical process, the transfer or gift of the patent of the invention and full details thereof by the inventor and developer to the public domain, after the patent term has expired, has proven to be a major way to promote industry and trade within the country. Certainly the American patent system has been a tremendous assist to the great industrial development of the country.

The formal rules and laws of obtaining, owning, and licensing of patents, are well codified in all of the industrialized countries, and in some of the less well developed ones. Where there is no formal code of practice, it is possible, in certain smaller countries, to obtain on a more or less individual basis, the grant of a special patent covering

some bit of essential technology. This may accommodate the transfer of technology if the grant is written so as to protect both the foreign owner of the technology and the domestic licensee thereof.

Usually, but not always, the transfer of technology through the license or sale of a patent, includes:- (a) the transfer of all related technology either not patented or not patentable, often called "know-how", and usually resulting from the experience of the licensor in operating his invention; (b) the agreement to transfer any new technology in the field either patentable or non-patentable, which the owner of the technology may develop or acquire during some reasonable period of time in the future; and (c) any necessary help on the part of the licensor to insure the operation of the technology transferred.

Most articles of commerce which are patented are produced in relatively large numbers and are readily purchased by anyone. Thus, any patented device, as an improved carburetor, usually may be bought readily - possibly at a price somewhat higher than it otherwise would bring because of the better features which justified the patent. Its novel features are thus immediately disclosed on examination and are readily available for immediate exploitation in any country where patents do not exist, or have not been obtained, as well as after the patents expire in those countries where patents have been obtained.

To some extent, this knowledge of a chemical process also may be secured from the patent or otherwise; and thus it may be utilized freely where not patented, although chemical processes are usually operated in the comparative secrecy of the owner's plant. Also, there are many details of

most processes which usually are not to be found in the patent paper. Some of these are engineering design and other aspects and materials of construction of the equipment used, optimum techniques and know-how of operations, specifications and optimum amounts of material used, optimum conditions of temperatures, pressures, fluid velocities, particle sizes, catalysts, etc.

All of these conditions are not always necessarily presented in the disclosure in order to obtain a patent; some may be omitted purposely by the inventor or his agent in writing the patent document or contract with the government, although he must swear that he is making a full and complete disclosure. Other points may not have been disclosed because they were not fully known or understood when the patent was written and applied for, although it may have been necessary to have determined and then optimized them completely before any operation could be successful commercially.

One may preserve only by a patent the monopoly justified by a worthwhile invention of an object or a device as say, the carburetor; while with chemical and other processing, there often is the alternative of maintaining a new process as a trade secret inside the walls of the producing plant. If the company can maintain the manufacturing plant secure against inspection by others, and otherwise prevent the outward diffusion of its technology, it may be able to maintain the monopoly which is the principal advantage of any patent, without taking any benefit of the patent system. Thus it does not have to make a disclosure of the process, whereby it will be open immediately to all countries wherein it is not patented; and to the first country, after the date of the patent's expiration.

Thus, the company may decide by maintaining a trade secret it will not publish the details in a patent for others: - (a) immediately to see and to be able to try hard to circumvent by some variation not covered by the patent, or (b) to utilise completely, openly, and immediately in a country where no patent exists, and later in the country where patented, after the patent term expires.

Most chemical companies employing proprietary technology, either consciously or unconsciously, try to protect their proprietary technology with a utilisation of both approaches. This may be particularly true with a very specialised process or product. If the company does not expect to transfer to others its technology either at home or abroad, and it feels that it would not be able to utilise fully the advantages of the patent systems, it may well consider whether to make the necessary disclosure in a patent.

As an example, consider a new photographic system including a new camera and a chemically sensitised film with improvements dependent on a newly devised manufacturing process. The camera might well be covered by every possible patent, since it must be widely distributed in the market place; and careful inspection of any one unit sold would immediately disclose the novelties, which could then well be copied by anyone, if not patented. However, it is possible that the materials used, and the chemical processing required to produce and sensitise the film which would be done within the confines and secrecy of the manufacturing plant, could not be discovered by any chemical or other analysis of the commercial

product, however widely it may be sold. Then the advantages and disadvantages of disclosure of the process in a patent would have to be evaluated against the nuisance and possible failure of maintaining the secrecy of the manufacturing of the specialized film for at least the term of a patent.

Often also, the novelties of the process and the materials used therein, might not be such as to deserve a patent grant. In some notable cases in American chemical processing, trade secrets in the processing and manufacture of many millions of items each year of very sophisticated products have been successfully maintained for at least several generations by utilizing the most elaborate secrecy and security systems.

With refined methods of chemical analyses, however, it is increasingly difficult to depend on the inability to determine the components of the products made and the processes used to make them from a small sample of the item commercially available. Thus, a reverse aspect of patenting is indicated. In one case, the patent covered the method of making a particular dye or pigment. An infringer studied the complete disclosure of the printed patent and made and sold the product as a printing ink. He sold it to the U.S. government for printing a particular color of postage stamp. The unusual color of the stamp attracted the original inventor, who was able to analyze and identify the minute amount of dye in the printing ink used on a single stamp. Since there was other possible process known for making the dye, he was able to compel the infringer to pay royalties throughout the life of the patent.

An example may be cited of licensing of the proprietary technology for the production of a major synthetic fiber through the use of the various patents covering it and its production. The contracting companies were in two different highly industrialised countries, each having a highly developed patent system. Both parties recognised the value of the product and the validity of the patents which had been obtained in both countries.

The licensor received a very handsome payment for the right to use all of its patents in the country of the licensee; but gave in return no know-how or technical assistance beyond that which appeared in the published patents themselves, and no promise of any other help - present or future. In legal terminology, the licensor merely gave a "quit claim" to the use of the inventions as disclosed in the patents. The licensee also had previously made very sophisticated researches and had developed its own manufacturing processes and know-how based on its own studies as well as the published information in the patents in question. Promptly it proceeded to produce and market the synthetic fiber.

Patent systems are a very sophisticated mechanism for aiding commerce, and particularly the transfer of technology within and between industrial countries. However, like many other conveniences to business, patents are not available in the less industrialised parts of the world. A considerable aid to the development of those under-developed countries which are anxious to industrialise rapidly would be the inauguration of a firm patent system which would allow inventions from every country to be patented therein. The transfer of proprietary technology then would be

aided greatly.

During the period after a patent has been applied for in those countries having a patent system, and before it is granted, the technology still must be treated with some degree of secrecy. Since it may be desirable to license it in other countries, each of which has its own patent system and laws, a large number of such applications must be filed.

The cost of such filing and prosecution of at least several thousand dollars for each patent in each country may represent a substantial investment for a small research and development company.

A means has been used of interesting companies in individual countries while the patent in the parent country is as yet unpublished; and secrecy must be maintained. This system, which has been used with some success, provides that the local company pays the patent costs in local currency to a patent attorney in that country. After the patent application is filed by the local patent attorney, he gives a copy of the patent application in the local language to the company. As part of the agreement, the company has the exclusive option, for some specified time, to negotiate for the license to use the process in question - now protected by the patent application.

The transfer of proprietary technology to the Arab countries would be aided tremendously if they had a patent system, particularly if they subscribed to the international "convention" and rules of the patent systems of most of the industrialized countries. Preferably it would be desirable if a patent system could be devised common to and covering all Arab countries - as is the goal of the European Common Market Countries, so that one patent disclosure and allowance would have the monopoly in all Arab countries.

V. PROPRIETARY TECHNOLOGY AS PART OF AN ENGINEERING PACKAGE

In many cases where patents are not available, the entire technology and know-how owned by a company often may be combined into a package for sale along with the engineering of the essential plant. This combined package is transferred to the group in the same or a different country which is interested in the production. Usually such a sale is made with assurances or guarantees of the resulting production as to quality, quantity, and cost; also when the operation is supplied with feed stocks or raw materials of given specifications, it will have certain specified maximum costs of operation as to power, steam, water, man hours of labor, etc. per unit of product.

The engineering in the package may be simply the process design, supplied to a competent mechanical engineering group - either employees of the purchasing company, or others responsible to it. These engineers then prepare the final mechanical drawings and submit them to the group supplying the technology, for correction and approval before going into work.

In the supply of proprietary technology 25 years ago to major manufacturing companies in Japan, often it was transferred along with the complete know-how and the process engineering under mutually agreeable terms. The mechanical engineering and design were then done by competent engineers of the operating company in Tokyo; and blueprints were sent back for comments and any necessary corrections in the U.S. Finally, the plants were built, installed, and operated under the supervision of the company engineers: - with complete success in all cases known.

This system was very attractive to the Japanese at that time, because of the very great differential between the direct costs of engineering services and its overhead in Japan as compared to the U.S. Furthermore, it allowed the design standards of fabrication to conform exactly with the Japanese practice and capabilities for fabrication of equipment. Particularly also at that time there was the necessity of minimizing the exchange of money from outside of Japan; and dollars were very expensive relative to yen. By this system, only a minimum of funds had to be transferred.

However, such assistance from local engineers is only possible when the plant is being built by a company in a relatively well developed country which is well industrialized and has an ample supply available of experienced engineers and fabrication shops for the equipment.

VI. PROPRIETARY TECHNOLOGY AS PART OF A TURN-KEY INSTALLATION

A "turn key" contract for a plant provides for all of the "soft ware" of technology and "hardware" of equipment. Everything supplied, usually by a firm of architect-engineers, complete in all details as an entirely functional unit within whatever "battery limits" of an overall processing facility may be specified and with all rights to its use. The purchaser is handed the key to the gate, turns it, and the plant leaps into action! The contract provides for it to produce immediately or after a specified time for "running in", an output of established amount and specifications from raw material also well defined. The total costs of production are also usually guaranteed, and to be made up of agreed amounts and costs of the several items involved.

While this entails possibly the least trouble and responsibility to the purchaser, it usually may be the most expensive. The contractor is entirely responsible for the proprietary technology involved which he has obtained in whatever form suffices for him to understand and agree with so completely that he is willing to risk thereon the entire cost of the plant, also his own efforts and reputation. The technology may or may not be disclosed to the purchaser who has no need to agree with its adequacy - nor does he need even to understand it in advance, since he is buying a complete and operating plant and is guaranteed the final production.

Usually the proprietary technology has not been developed by and often is not the exclusive property of the architect-engineer who is its seller. He has acquired it for the purpose of resale along with the engineering and the installed equipment to the present customer and possibly others. Where the proprietary technology is relatively well established as the most desirable for the given production, it may be offered through several different architect-engineers, each of whom has sufficient confidence to bid the plant, including the technology, to the prospective purchaser. Obviously the proprietary technology as well as the equipment must be demonstrated successfully in operation, if the plant is to be paid for, including the final payment, to satisfaction with all of the guarantees of the all-inclusive contract.

VII. PROPRIETARY TECHNOLOGY AS EQUITY IN A JOINT VENTURE

One system for transfer of proprietary technology involves a joint venture. This has been used by many of the large American companies in working with major Japanese companies, also with companies in many other less industrialised countries. It has proven equally successful in the transfer of technology to less well developed countries.

A new company is organised in the host country with values established for shares of the equity; and the local interests subscribe on a mutually agreeable basis for some or all of the capital funds which are required for building the plant and for supplying the necessary operating capital. The owner of the technology may also subscribe funds on the agreed basis; however, the proprietary technology itself is transferred for equity as shares of stock of the operating company. Depending on the relative value which is placed on the technology, one or more members of the Board of Directors are usually filled by an appointee of the original owner of the technology. Provision is necessarily agreed and guaranteed by the government of the host country that: - (a) the foreign equity in the company will not be expropriated by any form of so-called additional "participation" or "nationalization", (b) the earnings, reported as dividends, will be free for payment overseas.

A basic decision which is essential before such a company can be organised is the value to be accorded the proprietary technology which is transferred for stock in the new company. The face value of the

corresponding equity usually may be somewhat higher than the value of the technology in a cash sale, because of the relative lack of liquidity of the stock certificates.

On a ratio to the total equity, that percent paid for the technology will, of course, depend on whether it includes the process engineering - however defined - and the mechanical design and blueprints for the equipment and indeed possibly the plant equipment itself, either delivered or installed. Just the proprietary technology with the process engineering has been evaluated in various arrangements of this type of joint venture at from 10% to 50% of the total equity. Some countries place a limit of 50% to foreign participation.

The sophistication and novelty of the technology and its uniqueness, i.e., whether or not it is available from more than one source, will be important considerations in evaluation of the fair ratio of the value of the proprietary technology to that of cash which must be invested. Another consideration also will be the respective ratios of capital requirements to projected annual sales and to projected annual profits - or the projected payout time of the investment for the capital and operating expenses.

Overall considerations must be studied in somewhat greater depth if a joint company is thus established, in order to transfer

technology, by what is, in effect, a continuing partnership which must be organised so that the relationship will last indefinitely and amicably. Contrariwise, with a simpler system of transfer of technology, the deal may be over quite quickly, to everyone's satisfaction.

Of the many points often considered in making such an agreement, is the ratio of the ownerships of the two sides if the original business is expanded, and particularly if the expansion includes new technologies other than the original. If expansions are made only from profits, before they are paid out, obviously the ratio of equities owned by the two parties - suppliers of technology and suppliers of cash is maintained constant. In many such agreements, the needed capital for an expansion may be raised by an additional investment of the local partner, while the foreign partner has additional stock issued to maintain constant ratio of ownership.

VIII. BARTER OF PROPRIETARY TECHNOLOGY

Major operating corporations, which are not in the business of transferring technology or building plants, sometimes prefer not to place a monetary value on technology which is useful and desired by another company - possibly a competitor. Instead, such technology may be traded for other technology of the second company in the same or another field. Because of less flexibility in dealing with the respective intangibles without reduction to monetary values, precise evaluations are seldom possible.

Such arrangements of bartering technology for other technology are hardly possible in the present discussion. However, there are, of course, intangible values other than technology in many oil-producing countries which might be traded for proprietary technology in petrochemicals production that may be owned by the chemical divisions of some of the major foreign petroleum companies. Thus, modifications of this type of agreement may be important, where other more or less intangible values may be bartered for proprietary technology, or indeed for proportional shareholdings in a joint company.

A related transfer of technology from a foreign operating company with a local group having a source of supply of feedstocks may be either with or without financial participation in the new venture. Thus, if the foreign petrochemicals manufacturer has the technology, also the markets, it may agree to transfer to the local company - or other source of necessary feedstocks - its technology in return for offshore marketing rights for the petrochemicals which are manufactured. The capital structure and stock equities are subscribed on a basis mutually evaluated as fair.

IX. STEPWISE TRANSFER OF PROPRIETARY TECHNOLOGY

The purchase of proprietary technology, particularly if for petrochemical or other processes, which have not been operated in a substantial or well recognized plant on a large scale, may have a credibility problem to the buyer. The owner of the technology may be equally loath to make the transfer without assurance of full payment for that which he is, however, unwilling to demonstrate fully in advance. He feels that he is entirely without protection for his technology, which he would like to maintain in secrecy.

In one illustrative case, the transfer of technology was made on a stepwise basis. With the process involved, it was possible to demonstrate partially on a bench-scale with laboratory equipment which was almost standard. Sufficient information was supplied by the owner of the technology so that this could be done in the local company's laboratory, by its own technicians. First there was the payment of a modest percentage of the fee previously agreed upon. Satisfaction with this first bench-scale work led to the payment of a larger part of the fee. For this the foreign owner of the technology supplied the design of a small pilot plant with full information for its construction and operation by the local company's engineers. Again, the satisfactory performance encouraged the local company to pay more of the fee agreed upon. Then the complete engineering for a full size demonstration plant was supplied.

and utilised by the local company in a successful operation, after which as had been agreed, the final payment was made.

In this particular case, this was the first major operation of the process involved, thus the contract for the step-wise transfer of the technology provided that the local company could relinquish the contract at any time if it was unsatisfied with that released and demonstrated. Also it was provided that the local company would receive a share in the basic fee or royalties obtained from later customers in other countries as well. The demonstration plant built and operated by the local company was available now for inspection and analysis of the process and its economics by others, to whom licenses could be sold of the new proven process.

X. CONCLUSIONS

The universal desire of all developing countries is to industrialise. However, in most cases, the largest hindrances to industrialization are the supply of adequate capital and sometimes of adequate energy. With the removal of these hindrances, there are unusual opportunities for many of the Arab countries to industrialize. This may be done very rapidly through the transfer of proprietary technology from the technically more advanced nations, rather than through the relatively slow build-up of the necessary technology within the several countries through indigenous research and development programs.

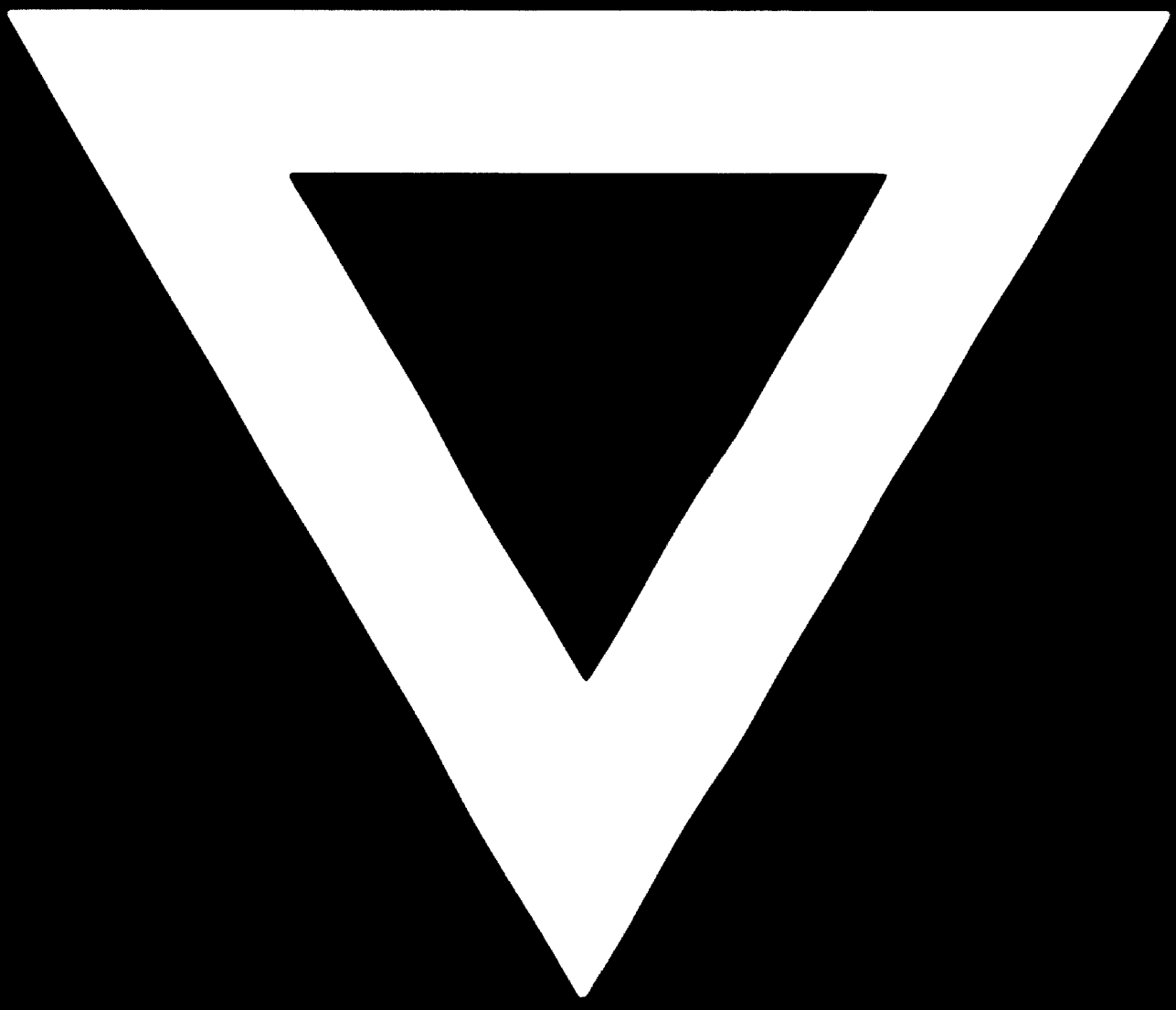
Nevertheless, other problems remain due to some extent to the lack of some of the mechanisms or facilities for such convenient transfer of technologies which have built up in industrial communities.

A principal one is the training of scientists and engineers to receive and utilize foreign technology, and to build and operate the necessary plants. These young men may be trained better and more quickly and economically in technical universities in Europe and America.

A second great institution of all industrial nations is its patent system. This allows the ready transfer of much, although not all, proprietary technology under a protection not available when disclosure otherwise depends on confidential treatment of trade secrets until agreement is made for their transfer. A first major step of the Arab nations in moving forward and into the industrialised world of the 20th Century would be to organize an effective patent system. Desirably,

this might be a United Arab effort with a single patent office, code of laws and practice. This office should issue a single patent for an invention, which would protect it throughout some federation of Arab states, however defined. Egypt, for example, already has a patent system which, some patent experts say-like those of every other country of the world, might be improved. However it might well be a starting point.

Until such time as patents are available, technology will be transferred, particularly in the petrochemical and fertiliser fields by various systems, and variations thereof, some of which have been described.



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